Circular No. 866

Revised January 1951 · Washington, D.C.

UNITED STATES DEPARTMENT OF AGRICULTURE

The Lymph Glands of Cattle, Hogs, and Sheep[1]

By R. K. SOMERS,[2] *Chief, Inspection Procedures Section, Meat Inspection Division, Bureau of Animal Industry, Agricultural Research Administration*

CONTENTS

INTRODUCTION

Persons engaged in meat inspection should have a thorough knowledge of the lymphatic system of animals, the flesh of which is used for food. The reason for this is that, in many cases, final judgment as to the fitness or unfitness of meats for human consumption is based largely on conditions in the lymph glands of the slaughtered animals.

[1] Supersedes Circular 32, The Regional Lymph Glands of Food Animals, by J. S. Buckley and Thomas Castor.

[2] Assistance in preparation of this circular, furnished by O. W. Seher, inspector in charge of meat inspection, Chicago, Ill., J. R. Scott and W. R. Kidwell, Meat Inspection Division, Washington, D. C., and M. R. Clarkson, in charge, Inspection and Quarantine Division, Washington, D. C., is gratefully acknowledged.

920690°—51——1

Much of the information presented in this circular has been obtained from various works on the subject, and this information has been supplemented by data obtained in first-hand, practical experience.

THE LYMPHATIC SYSTEM

The lymphatic system consists of the lymph and its cellular constituents, the lymph vessels and lymph glands, together with certain accessory lymphatic structures.

The Lymph

Lymph, derived almost entirely from blood, has a composition similar to that of blood plasma. The blood plasma which passes through the thin wall of the blood capillaries, into the tissue spaces, is known as tissue fluid or lypmh. The cells of the tissues also contribute to the composition of lymph in the interchange between cell fluid and fluid in the tissue spaces. In the tissue spaces and finest lymph radicles, the lymph has a low cellular content. After passing through the lymph glands lymphocytes are more abundant in the lymph. Neutrophilic leucocytes are present in great numbers in infections but are ordinarily absent otherwise.

The Lymph Vessels

The lymphatic system in a normal, healthy animal is made up of a system of tubes, sometimes called the white blood vessels, beginning in the tissue spaces as blind lymph capillaries and converging to form smaller, then larger lymph vessels. The system comprises an intricate and extensive network in practically all tissues except muscle bundles, intermuscular sheaths, nerves, and blood vessels. The system terminates in two large lymph vessels, known as the thoracic duct and the right lymphatic duct, which empty into the blood vascular system near the junction of the jugular veins in the anterior vena cava.

Involutions of the endothelial lining of the lymph vessels form valves which correspond to and resemble the valves of veins, but are much more numerous. The smallest lymph vessels or lymph capillaries do not contain valves and there are few valves in the thoracic duct except for several at its juncture with the veins which prevent the flow of blood backward into the thoracic duct. In all lymph vessels of intermediate size, the valves may be readily seen as constricted areas about one-sixth of an inch apart in preparations which have been injected for study.

In many respects the lymph vessels simulate the veins of the blood vascular system in both structure and function. Actually, they are adjuncts of that system.

The capillary lymph vessels are formed by a single layer of endothelial cells in the same manner as are the smallest of the blood capillaries and are reported to have their origin in terminal culs-de-sac instead of in open intercellular spaces. The structure of other lymph vessels is similar to that of veins, but the former have thinner walls.

Lymph in the tissue spaces is in communication with the blood in the capillaries, the fluid in the cells, and the lymph in the lymph

capillaries. This lymph removes from the tissue spaces materials such as particulate matter and large molecules (proteins and lipids) which cannot enter the blood capillaries but can penetrate the more permeable wall of the lymph capillaries.

The flow of lymph in the lymph vessels is sluggish and in one direction only—from the tissues toward the heart. Factors influencing the lymph flow are: (1) The difference in pressure at the two ends of the lymph system (higher in the capillaries and lower in the thoracic duct), (2) the massaging effect of muscular movements, and (3) the valves in the lymph vessels which permit flow in one direction only.

The lymph collected by the lymphatics from all parts of the body is finally emptied into the blood stream through the two large vessels already mentioned—the thoracic duct and the right lymphatic duct.

The thoracic duct has its origin in a very irregularly shaped cystic dilation known as the cisterna chyli or receptaculum chyli, located beneath the first lumbar vertebra near the adrenals. From this origin it extends forward through the diaphragm (in cattle by a special opening), passes along the lower surface of the vertebrae and above the aorta to the apex of the thorax, and empties into the anterior vena cava. This duct receives the lymph from all parts of the body except the right fore limb and the right half of the head, neck, and thorax. The thoracic duct is sometimes double throughout its extent, originating in the one reservoir and emptying at the junction of the two jugulars.

The right lymphatic duct is an extremely short trunk which receives the lymph from the right side of the head, neck, thorax, and right fore limb and empties into the venous system at the junction of the jugular veins or anastomoses with the thoracic duct just above the point of juncture with the anterior vena cava. It is formed by the efferents of the prepectoral glands of the right side.

The Lymph Glands

On the course of the lymph vessels are situated adenoid structures called lymph glands. The glands are nodular, varying in size from almost imperceptible points to that of a hen's egg, and varying also in different species of animals. They may be flattened, round, cylindrical, or, more usually, reniform. The lymph vessels approaching a gland break up into many branches and enter the gland on its convex border in an oblique direction. They are known as afferent vessels. These are the conduits that convey the lymph directly from the various tissues to the corresponding lymph glands. After traversing a complex labyrinth of channels in the gland and having its composition altered both chemically and histologically, the lymph leaves the gland by the efferent lymph vessels which originate at the hilus of the gland on its concave border. These efferent vessels either enter into another lymph gland or lead directly to the cisterna chyli, the thoracic duct, or the right lymphatic duct.

An idea of the structure of a gland may be had from a study of the lymph follicles in the walls of the intestines, and then of a plexus of lymph vessels, within the meshes of which are simplified collections of germinating lymphatic cellular elements.

A lymph follicle as found in the intestinal mucosa is nothing more than a small, round aggregation of proliferating lymph cells held in a very delicate stroma of adenoid connective tissue and penetrated by a richly arborescent capillary arterial twig which furnishes nutriment. Surrounding some of these aggregations of lymphatic cellular elements is an extremely delicate connective tissue capsule opening into and continuous with the surrounding lymph capillaries, similar to the Bowman's capsule covering a Malpighian corpuscle in the kidney.

The lymph gland may be considered as a large collection of these simple lymph follicles held together by a connective tissue framework containing trabeculae which separate the follicles, and surrounded by a thick capsule from which the framework takes its origin. In the lymph glands of some animals, involuntary muscle fibers are intermixed with the fibers of connective tissue. The individual follicles of this compound gland do not completely fill the alveoli formed by the trabecular framework, but are surrounded in each instance by a hollow space which corresponds to the space between the capsule mentioned above as around a solitary follicle and the follicle itself. In the compound lymph gland these spaces are continuous with one another toward the medullary portion of the gland. The follicles of the medullary portion are elongated structures and are known as medullary cords. The intercommunicating follicular lymph spaces finally are continuous with the efferent lymph vessels of the gland.

For convenience, the structure of lymph glands is usually described as being divided into a cortical and a medullary portion, the only difference in the two being in the shape of the lymph adenoid structures; those in the cortical portions are round and called cortical follicles, and those in the medullary portion are elongated and known as medullary cords. The spaces surrounding the follicles and cords are known as the lymph sinuses, and it is through the sinuses that the lymph passes on its way from the afferent to the efferent lymph vessels. It is while traversing these tortuous sinuses that the lymph is altered in composition.

From the standpoint of meat inspection it is well to remember that foreign and deleterious matter that has been taken up by the lymph on its passage through the different tissues is usually removed or destroyed by a process of filtration or by chemical counteraction. This function of the gland is very important, as certain deleterious substances such as infectious micro-organisms (tubercle bacilli for a specific example), if emptied by the lymphatics into the blood stream, would probably be distributed throughout the whole system and would be likely to set up a generalized infection—a septicemia—which would probably soon terminate in death.

The bacteria filtered out or retained temporarily by lymph glands are often destroyed and disintegrated. That is not always the case, however, and bacteria may even pass through a lymph gland without leaving any trace of their passage. Many of the bacteria which are retained are destroyed by phagocytic action, or, not being destroyed they produce disease in the glands. Other substances such as particles of carbon are filtered out and may be readily seen in the bronchial glands of nearly all old animals. Blood and tissue pigments are seen

in the glands where there has been a destruction of these tissues upstream. Parasites also are found at times in the lymph glands.

The lymph as it leaves the lymph gland is much altered. In the gland large numbers of lymphocytes are produced and some of these cells are added to the lymph. The lymphocytes play an important part in protecting the body from infections. The lymph with its new charge of lymphocytes and of modified waste from tissues is now ready to be emptied into the blood stream, to be passed along to the excretory organs.

That lymph glands filter out and modify deleterious matters cannot be very readily demonstrated by simple microscopic means in a young, healthy animal, but it is clearly shown in cases of infections of individual organs and regions, and in old animals where pigmentation of these glands is often observed. The meat inspector is most often obliged to depend on such findings in making his decision of health or disease, and in deciding localization or generalization of disease and fitness or unfitness of meat for food purposes.

If the lymphatic system is the "scavenger of the body," if it is the first line of defense in protecting the body from disease, it also furnishes a route for entry of disease and in certain cases acts as a disseminator of disease. Those malignant neoplasms and infectious diseases which by intent or chance have become inoculated into the body are not long held in abeyance by the lymph glands, and in such cases the lymph vessels act as ways of transport, to the detriment of the whole body.

In consistence, size, and color the lymph glands vary considerably. In young, rapidly growing animals the glands are rather prominent and contain more fluid; in old and mature animals they are more firm and compact. Sometimes in old milk cows the lymph glands may be rather prominent, but they are usually fibrous in texture. The visceral lymph glands are softer in structure than those in other parts of the body, those of the abdominal digestive organs containing more fluid, especially during absorption from the intestines.

The center areas of the mesenteric glands are usually darker in color than the outer area. The colors found vary from white to dark gray, brown, red, or even black.

The hemolymph glands differ from the lymph glands in color and structure. They are of a deep red color or even black, owing to the high vascularity of the cortical substance. Some have afferent and efferent lymph vessels and others do not. They are numerous in cattle and sheep, occurring as small bead-like structures along the aorta, in the perineal fat, at the portal fissure, with the gastric and mesenteric lymph glands, under the trapezius muscle, under the skin in the upper part of the flank, and in other places less constantly. Their significance is not clear.

Black lymph glands, or mottled black and white ones, while not normal, can not be said to be always really diseased, since the color may be due to mere disposition of normal pigment or to carbon particles which have no special significance, at least from a meat-inspection standpoint. The cortical portions of many lymph glands are white or light grey, while the medullary portions are rather dark in color. In many old animals the lymph glands are fibrous in texture, and on section are of a yellowish-white color.

Although the routes of the lymph vessels are more or less constant, there may easily be diversions of the normal or usual flow of lymph, due to various causes, the most important being retrograde movements due to blocking of the lymph channels in disease, as in malignant neoplasms and other conditions. Anastomoses of lymph vessels of adjacent regions may occur, as in inflammatory adhesions of one lobe of the lung with an adjacent lobe, or adhesion between the visceral and parietal or the visceral and mediastinal pleura, etc. All such points must constantly be kept in mind in order to render intelligent judgment in a seemingly unexplainable finding.

The discussion of the various glands will proceed somewhat in the order of examination of the carcass as conducted at the time of evisceration or, following the plan of inspection, by passing from terminal to central lymph structures as the lymph flows.

THE CERVICAL LYMPH GLANDS

The term "cervical lymph glands" as used by the Federal meat inspection service includes the mandibular, atlantal, parotid, suprapharyngeal, and parapharyngeal lymph glands. These are very important in inspection and must be examined carefully. In hogs, especially, these glands frequently present the first and often the only lesions of tuberculosis found in the entire carcass.

The Mandibular Lymph Glands

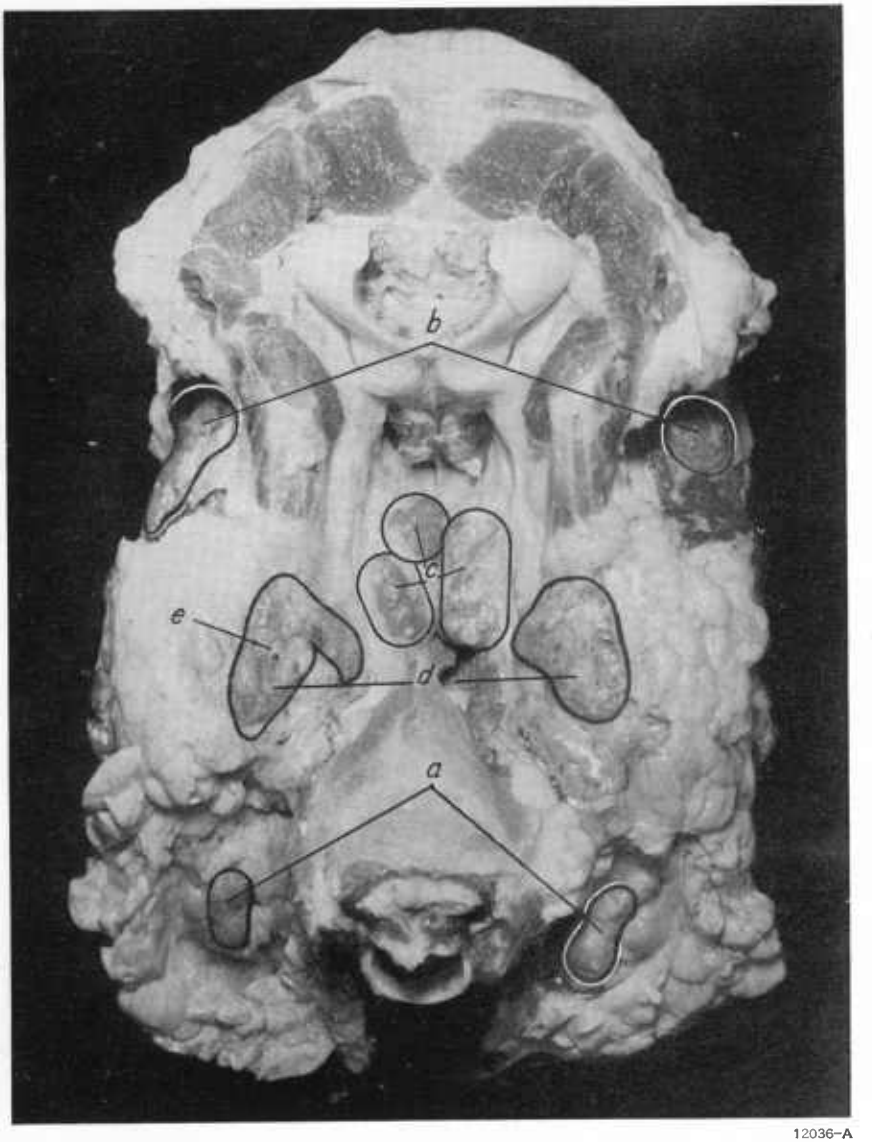
The mandibular lymph glands in cattle are located in the lower portion of the mandibular space, between the inner surface of the mandible and the mandibular salivary glands, about 2 inches anterior to the point where the lower border of the mandible curves upward and above the anterior attachment of the sterno-cephalicus muscle. Usually there is but one gland on each side, but occasionally there are two glands lying very close to each other (fig. 1, *A*).

In hogs, these glands are covered by the salivary glands and lie more posteriorly than in cattle (fig. 2, *A*).

The efferent vessels come from the muzzle, lips, cheeks, hard palate, the anterior part of the turbinates and septum nasi, the gums (in part); the sublingual and parotid glands; the tip of the tongue; the muscles of the head except those of the eye, ear, tongue, and hyoid bone; the mandible, premaxilla, and nasal bone; and the skin of the face in part. The efferent vessels, two or four in number, lead to the atlantal gland.

When cattle are slaughtered, the head is severed from the carcass without removing the tongue and is inspected after being placed face downward on a metal head-inspection rack or suspended from a hook inserted into the foramen magnum. A longitudinal incision should be made along the inner border of the sterno-cephalicus muscle just within the lower border of the mandible where the gland will be easily found adjacent to the mandibular salivary gland.

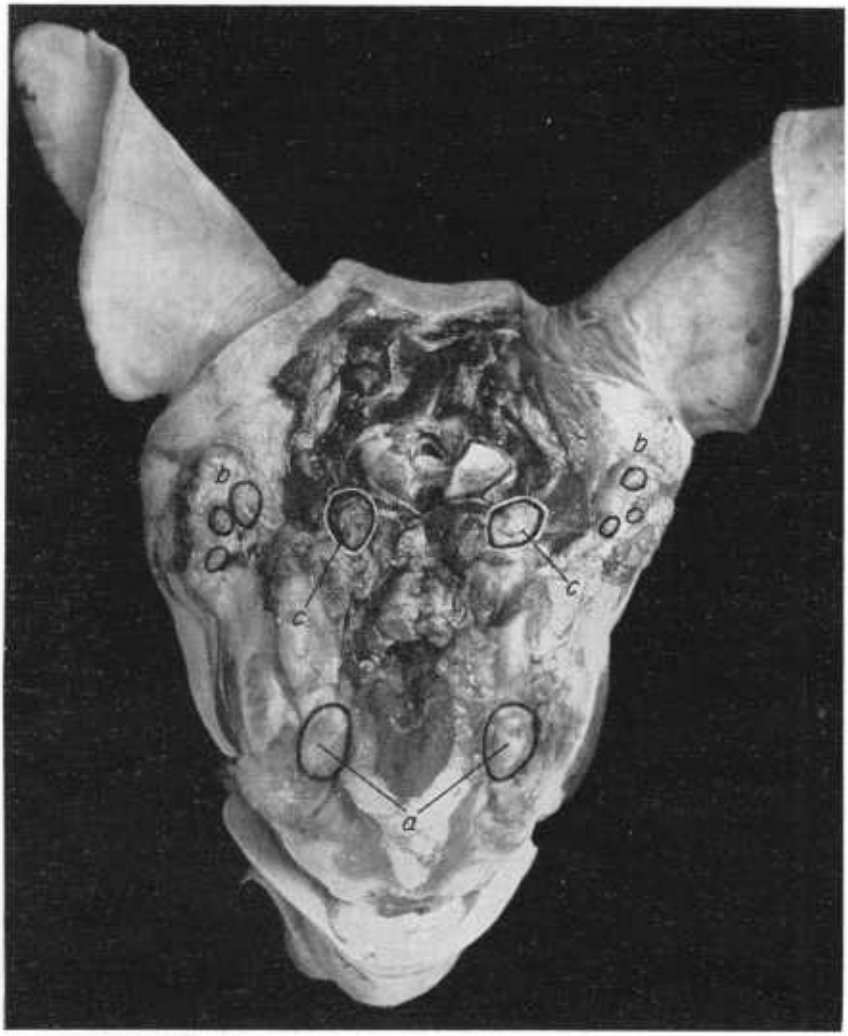
In hogs the method of reaching the mandibular lymph gland is similar to that described for cattle.



12036–A

FIGURE 1.—Head of cow in position for inspection, with lymph glands exposed. *a*, Mandibular lymph glands; *b*, parotid lymph glands; *c*, suprapharyngeal lymph glands; *d*, atlantal lymph glands; and *e*, hemolymph gland.

After the hog carcass is shaved and cleaned on the carcass dressing rail, the head is "dropped" by disarticulating the head at the atlanto-occipital joint, leaving the head hanging free from the carcass except for a small attachment by the skin of the neck. The mandibular lymph glands are thus partially exposed at the base of the tongue just inside of each angle of the lower jaw. Most inspectors use a small metal



12033-A

FIGURE 2.—Head of hog in position for inspection, with lymph glands exposed. *a*, Mandibular lymph glands; *b*, parotid lymph glands; and *c*, suprapharyngeal lymph glands.

hook with which the salivary gland is drawn outward and twisted slightly, thus allowing the mandibular lymph gland to be easily and rapidly incised for inspection. Both experience and deftness with a knife are necessary to locate and incise these glands rapidly and accurately in efficient inspection.

THE PAROTID LYMPH GLANDS

In cattle the parotid lymph gland is located on the posterior part of the masseter muscle and is partly covered by the parotid salivary

gland, being partly embedded therein and lying about 1 inch in front of and a little lower than the external meatus of the ear (fig. 1, *B*).

In hogs the numerous parotid lymph glands are reddish brown in color. They vary in size and are arranged in a chain along the anterior border of the parotid salivary gland and posterior to the border of the mandible (fig. 2, *B*). In the method of slaughter whereby the jowls are allowed to remain attached to the carcass, very often one or more of the parotid glands are left intact on the innner surface of the jowl after the head is removed. When the jowls are removed from the carcass with the head, these glands may often be exposed, as they are frequently cut through when the head is severed from the body. In some cases they may be entirely removed with the head and jowls, or in others they may remain attached to the carcass, depending entirely upon the manner in which the head is removed.

The afferent vessels come principally from the muzzle, lips, muscles of the head, anterior part of the turbinates and nasal septum, parotid salivary gland, external ear, mandible, eyelids, lacrimal gland, frontal, nasal, and premaxillary bones, and the skin of the head. The efferent vessels go to the atlantal lymph gland.

The Suprapharyngeal Lymph Glands

In cattle the suprapharyngeal lymph glands are located at the base of the cranium just superior to the pharynx, lying close together on each side of the median line between the branches of the hyoid bone (fig. 1, *C*). These glands average about 2 or 3 inches in length.

In hogs they are usually very small and are situated more posteriorly than in cattle, on the lateral plane of the larynx and the pharynx at about the lower end of the paramastoid process of the occipital bone (fig. 2, *C*).

The afferent vessels come principally from the tongue, hard and soft palate, floor of the mouth, pharynx, sublingual and mandibular salivary glands, larynx, nasal cavity, and maxillary sinus. The tonsils, in cattle at least, have four or five large ducts that empty directly into the suprapharyngeal glands.

The efferent lymph vessels combine with those from the atlantal lymph gland to form the tracheal lymph duct.

It will readily be seen how very important these glands are, from a meat-inspection standpoint, as they receive most of the efferent lymph radicles of the entrance to both the digestive and respiratory tracts. These glands are often the first to show tuberculous infection.

The suprapharyngeal lymph glands in cattle may be exposed as follows: After the head has been removed from the carcass and placed upon the head-inspection equipment, draw the larynx forward and downward, then make a transverse incision near the base of the cranium which will reveal the glands lying on the superoposterior surface of the pharynx.

In hogs the method of locating these glands is similar to that described for the mandibular glands, the only difference being the slight variation in location, the suprapharyngeals being situated in a mass of fat at each side of the larynx and pharynx. They are not so large or prominent as the mandibular glands.

920690°—51——2

The Atlantal Lymph Glands

In cattle the atlantal lymph glands are located ventral to the wing of the atlas and partly under cover of the mandibular salivary gland (fig. 1, *D*). They are related ventrally to the carotid artery, are usually discoid, and about 1½ to 2 inches in length. One or more small lymph glands may occur near the large constant ones, and small hemolymph glands are commonly present here (fig. 1, *E*).

The afferent vessels come principally from the tongue, the salivary glands, the gums in part, the cervical portion of the thymus, the hyoid and cervical muscles, and the parotid, mandibular, and suprapharyngeal lymph glands. The efferent vessels, three to six in number, combine to form the tracheal lymph duct.

THE ANTERIOR AND MIDDLE CERVICAL LYMPH GLANDS

The anterior and middle cervical lymph glands vary in number, size, and location. In cattle they are generally located on each side of the anterior and middle third of the trachea and along the course of the carotid artery. In hogs the middle cervical lymph glands form a group along the course of the external jugular vein.

The afferent vessels come principally from the atlantal lymph gland, the esophagus, larynx, trachea, thyroid and thymus glands, and the ventral muscles of the neck. The efferent vessels go to the posterior cervical or prepectoral lymph glands.

THE PRESCAPULAR LYMPH GLANDS

The prescapular or posterior superficial cervical lymph glands are located a little above and inward from the shoulder joint. They are embedded in a cushion of fat and covered by the brachiocephalicus muscle. In cattle the glands are elongated and may attain a length of 4 or 5 inches and a width of an inch or more. In hogs the glands form a more or less completely fused chain. These glands play an important part in deciding the question of generalization of disease—tuberculosis, for example—as all the afferent vessels are derived from ducts that are not connected with any other lymph area. In other words, this lymph area is an isolated area, and any secondary infection coming into it must first be brought to it through the medium of the blood vessels. Perhaps inflammatory conditions which would cause anastomoses with the lymph vessels of an adjoining region might take place. In this manner pleural lymph radicles could become fused with deep-lying lymph vessels on the pectoral wall, and these vessels in turn pass over the shoulder to the prescapular lymph glands. It would seem that such a roundabout course could hardly take place. Of course, disease of these glands without other centers of infection would point to a primary local infection.

The afferent vessels come principally from the skin of the neck and shoulders; muscles of the shoulder, forearm, and digit; joints of the carpus and digit; and a portion of the thoracic wall.

The efferent vessels pass into the prepectoral lymph glands or, on the right side, into the right tracheal duct and, on the left side, into the terminal part of the thoracic duct or the left tracheal duct.

In cattle the glands may usually be felt by pressing the hand forcibly in the hollow of the shoulder, in front of the neck of the scapula. In a hanging carcass, an incision 3 inches long, parallel to the muscle fibers along the superior border of the brachio-cephalicus muscle just inward from the shoulder joint, is sufficient to allow the inspector to grasp the gland for examination (fig. 4, *A*).

In hogs the glands are most easily reached from the internal or split surface of the carcass by a transverse cut just in front of the shoulder joint to the anterior border of the anterior deep pectoral muscle.

In hogs supplementary cervical lymph glands which are considered a part of the prescapular group of lymph glands are located above the principal prescapular lymph glands, beneath the angular muscle of the scapula, external to the lower part of the second cervical vertebra, embedded in a mass of fat. The afferent vessels are from the deep, muscular layer at the base of the neck. The efferent vessels pass to the superficial cervical or prescapular gland.

The gland in the hog can be reached, after the carcass has been split, by cutting through the neck muscles inferior to the first and second cervical vetebrae. To reach the gland in this manner mutilates the neck somewhat and occasionally the shoulder to a slight extent. In the hanging, split carcass with head removed, a better way is to make a free upward incision between the neck muscles covering the first and second cervical vertebrae and the layer of superficial fat. This method causes very little mutilation. The gland can then be readily reached in a cushion of fat somewhat anterior to the scapula, and removed for examination.

In cattle these supplemental glands do not exist.

In the superficial parts of the base of the neck and shoulder are several other small and relatively unimportant lymph glands.

It is especially important to examine the prescapular lymph glands in sheep to detect disease such as caseous lymphadenitis. In sheep the glands are located as in cattle (fig. 8 *C*).

THE AXILLARY LYMPH GLANDS

The axillary lymph glands in cattle are located on the inner surface of the internal scapular muscles, posterior to the shoulder joint, in the midst of the brachial vessels and nerves where these emerge from the thorax and enter the leg. The glands are variable in number and usually are smaller and more flattened than any of the glands so far described.

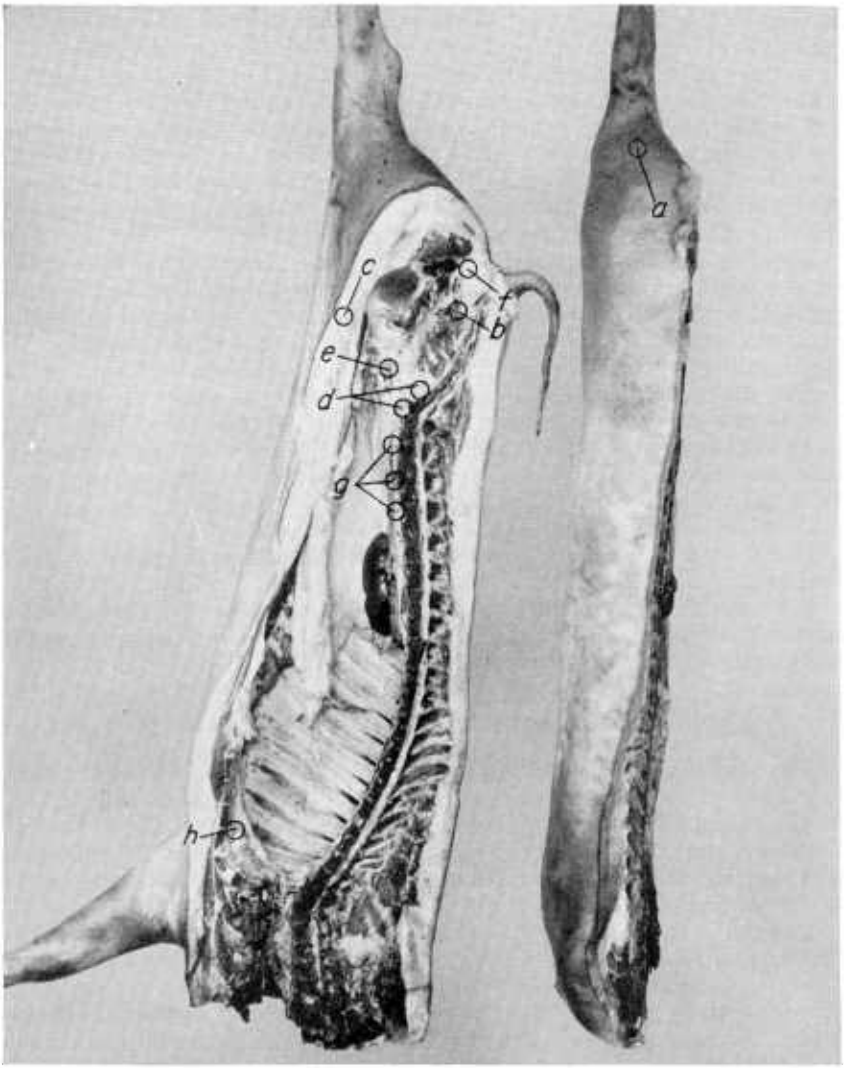
In cattle the gland may be easily reached from the inner surface of the split carcass, as it lies just lateral to the first or second rib (usually the latter) at about midway between its two extremities; and by cutting through the muscles along the anterior border of the first rib near its middle, the gland may be readily located embedded in a cushion of fat. This gland is not examined in routine post-mortem meat inspection.

In the hog the axillary lymph glands are usually missing.

The axillary lymph glands receive their afferent vessels from the middle and inner scapular regions, from the lower arm, forearm, and foot, and from the thoracic walls. Their afferent vessels pass to the prepectoral or posterior cervical glands.

THE PREPECTORAL LYMPH GLANDS

In cattle and hogs the prepectoral or posterior cervical lymph glands are located at the entrance to the thorax on or between the

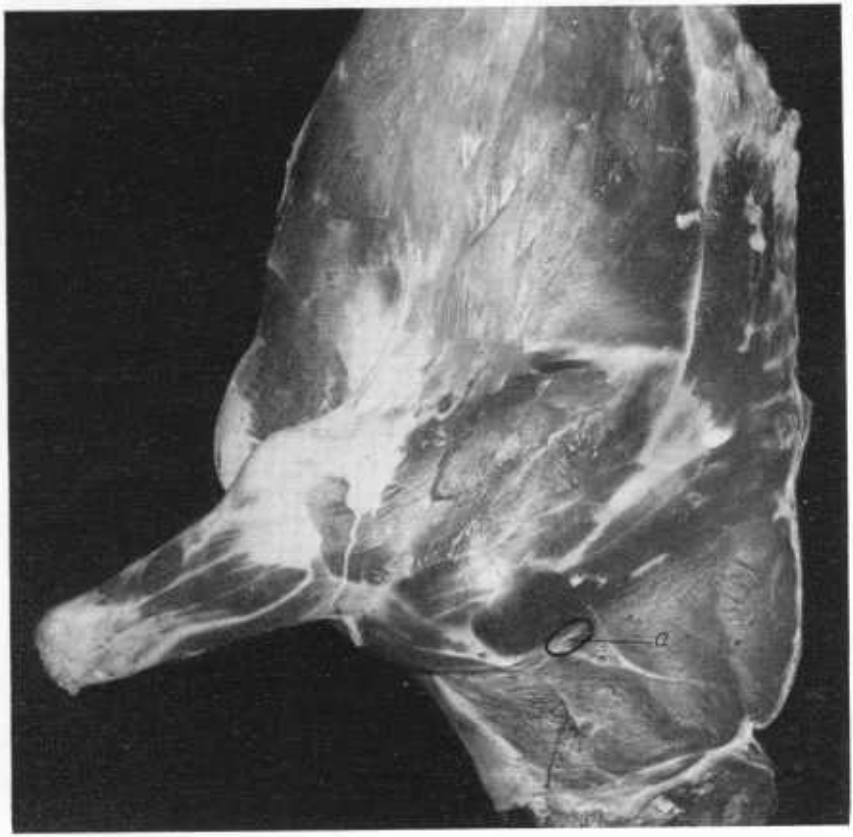


45034–B

FIGURE 3.—Lymph glands in the hog carcass. *a*, Popliteal lymph gland; *b*, ischiatic lymph gland; *c*, supramammary lymph gland; *d*, sacral lymph glands; *e*, internal iliac lymph gland; *f*, anal lymph gland; *g*, lumbar lymph glands; and *h*, sternal lymph gland.

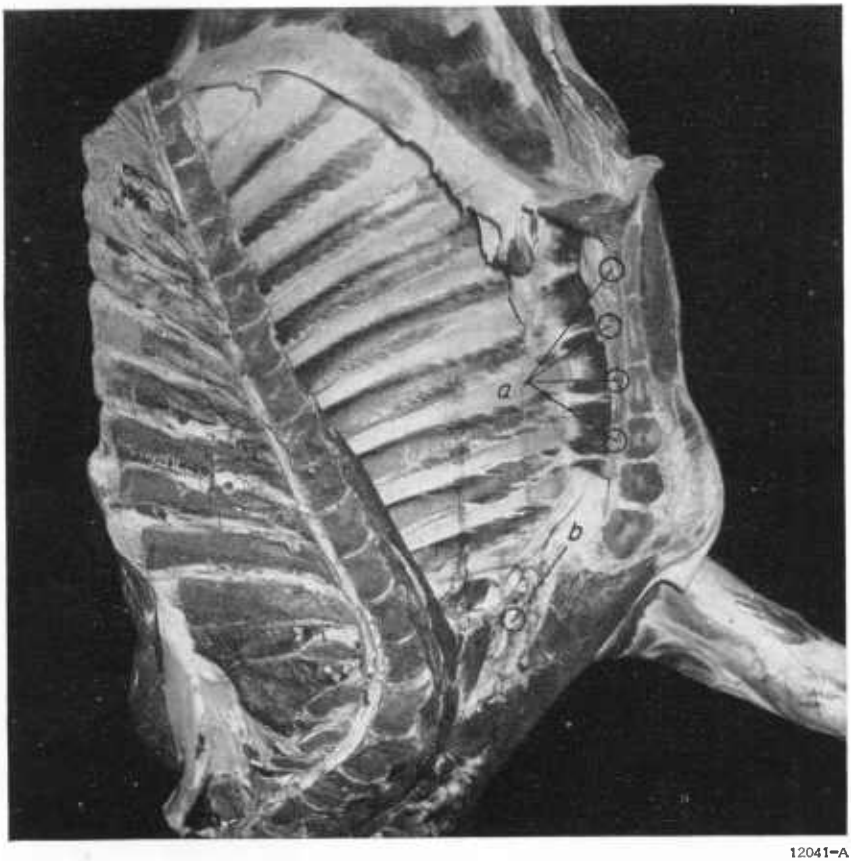
lower anterior borders of the first two ribs to the side of and inferior to the trachea and esophagus, usually embedded in fat that also acts as a cushion for the large veins and arteries in that location (fig. 5 *B*).

These are very important glands to examine as they are the terminal glands through which most of the lymph from the head, neck, and fore-extremities passes on its way to the thoracic and right lymphatic duct. They also receive afferents of the sternal lymph glands on their passage to the thoracic duct, and of several small lymph glands in the anterior mediastinal space. They bear the same relation to the anterior portion of the animal as do the lumber glands to the lymph vessels of the posterior regions. The afferents of the prepectoral lymph glands on the right side empty into the right lymphatic duct and on the left side into the thoracic duct, or occasionally into the anterior vena cava. These glands are sometimes found to be affected with tuberculosis, so that lesions of that disease may be thus detected even after the viscera have been removed and are no longer available.



12042-A

FIGURE 4.—Right forequarter of beef. *a*, Prescapular lymph gland.



12041-A

FIGURE 5.—Right forequarter of beef, interior view. *a*, Sternal lymph glands; *b*, posterior cervical or prepectoral lymph glands.

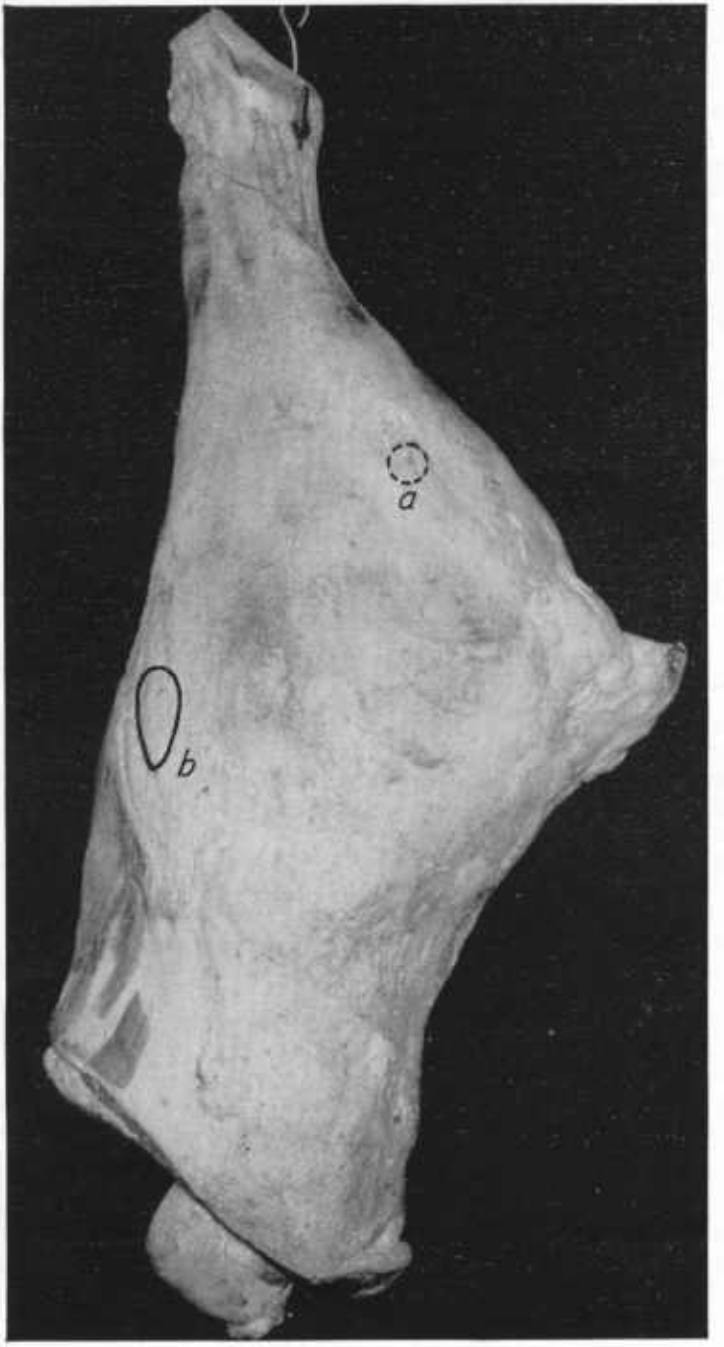
These glands, or at least a part of them which practically always remain in the hanging split carcass of beef, may be easily reached by inserting a knife into the cut end of the large, venous trunk referred to above, and making a downward longitudinal incision parallel to the fibers of the long muscles of the neck where the gland may be readily found embedded a short distance in the fatty cushion.

In the split hog carcass these glands may be exposed by making a transverse incision just anterior to the first rib.

THE POPLITEAL LYMPH GLANDS

The popliteal lymph glands are located deep in the muscles behind the stifle joint on the gastrocnemius between the semitendinosus and biceps femoris muscles at about the point of bifurcation of the gastrocnemius (fig. 6, *A*).

In hogs the popliteal lymph glands are small and more superficially located than in other animals and may be found in the subcutaneous tissues 3 or 4 inches above the hock (fig. 3, *A*).



12050–A

FIGURE 6.—Hindquarter of beef, external view. *a*, Popliteal lymph gland; *b*, prefemoral lymph gland.

To reach the popliteal lymph gland in the hanging cattle carcass, make a deep incision on the posterior part of the thigh, parallel to the muscle fibers between the biceps femoris and the semitendinosus muscles, on a line from the point of the ischium to the point of the os calcis, at the intersection of a horizontal line drawn backward from the patella. The gland may then be found between the muscles on a cushion of fat at the bifurcation of the gastrocnemius.

The afferent vessels originate in the lower portion of the hind leg. The efferent vessels usually pass to the ischiatic lymph glands but may pass by these glands to the lumbar, internal iliac, or deep inguinal lymph glands.

THE ISCHIATIC LYMPH GLANDS

The ischiatic lymph glands are located on the deepest and outer part of the lesser sciatic notch, adjacent to the external surface of the bone, covered by the sacrosciatic ligament of the pelvis, on the ventral border of the coccygeal muscle (fig. 3, *B*; fig. 7, *A*).

The afferent vessels are derived from the surrounding region and from the efferent branches of the popliteal lymph glands, although these sometimes pass very near this gland without entering it. The efferent vessels pass to the iliac lymph glands.

This gland may be found by making a transverse incision through the sacro-sciatic ligament adjacent to the lesser sciatic notch.

THE PREFEMORAL LYMPH GLANDS

The prefemoral lymph glands are situated on the aponeurosis of the obliquus abdominis externus, in contact with or close to the tensor fasciae latae and 5 or 6 inches above the patella. The gland has an elongated elliptical outline and is flattened. Its average length in cattle is 3 or 4 inches and its width about 1 inch, but it may be considerably longer. In this region may also be found several smaller lymph glands and hemolymph glands (fig. 6, *B;* fig. 8, *B*).

In animals in good condition it is embedded in a mass of fat. It is one of the most accessible glands in the dressed carcass, and is as important from the meat-inspection standpoint as is the prescapular gland in the forequarter.

It receives afferent vessels from the skin of the posterior part of the thorax, abdomen, pelvis, thigh, leg, tensor fasciae latae, and the prepuce.

The efferent vessels ascend on the deep face of the tensor fasciae latae and end chiefly in the deep inguinal gland, but in some cases go to the iliac glands.

In the hog this gland can be readily found with little mutilation of the carcass by making an incision through the inner abdominal wall nearly perpendicular to the vertebral column and in front of and above the femorotibial articulation.

In cattle it is most easily reached from the external surface of the carcass in the region known to the butcher as the "fell" by cutting down somewhat more deeply than is ordinarily done by the butcher in dressing a beef carcass, or by making a longitudinal incision into the "fell" along the anterior border of the tensor fasciae latae.

THE SUPERFICIAL INGUINAL AND SUPRAMAMMARY LYMPH GLANDS

The superficial inguinal lymph glands in bulls are located at the neck of the scrotum beside the penis in front of the inguinal ring; in steers they are embedded in the scrotal (cod) fat (fig. 7, *B*). In cows these glands are situated bilaterally at the posterosuperior part of the mammary gland and are known as the supramammary lymph glands. In hogs the supramammary lymph glands are located relatively as in cattle, there being one or more glands on each side posterior to the last segment of the compound mammary glands (fig. 3, *C*).

The afferent vessels come from the udder, the external genital organs, and part of the skin of the thigh and leg. The efferent vessels converge to two or three large trunks which go to the inguinal lymph glands.

THE DEEP INGUINAL LYMPH GLANDS

The deep inguinal lymph gland is situated ventral to the psoas minor, at the angle of divergence of circumflex iliac from the external iliac artery. It is discoid and is commonly 2 or 3 inches in length in cattle. A smaller gland may be present near the larger one or at the origin of the prepubic artery.

The afferent vessels come chiefly from the abdominal muscles, pelvic limb, urinary organs, vesiculae seminales, tunica vaginalis, cremaseter muscle, and superficial inguinal, external iliac, sacral, prefemoral, and popliteal lymph glands.

The efferent vessels go in part to the internal iliac lymph glands and in part directly to the receptaculum chyli.

THE SACRAL LYMPH GLANDS

Located along the inferior face of the sacrum, near its lateral border, the sacral lymph glands are very small and correspond in position to the glands lying along the spinal column in the thoracic and lumbar regions (fig. 3, *D*; fig. 7, *C*). They receive their afferent vessels from the coccygeal region, posterosuperior sacral region, and rectum. Their efferent vessels pass to the internal iliac and deep inguinal lymph glands.

Along the dorsal surface of the rectum are numerous small lymph glands whose efferent vessels pass to the sacral or lumbar lymph glands.

THE EXTERNAL ILIAC LYMPH GLANDS

There are one or two external iliac lymph glands on each side at the bifurcation of the circumflex iliac artery. In the majority of cases a single gland is found just in front of the origin of the anterior branch of the artery, but another may lie in the angle between the two branches. The more constant one is ½ to 1 inch in diameter. They may be absent on one side but rarely on both sides.

The afferent vessels come from the abdominal muscles, gluteus profundus, tensor fasciae latae, fasciae latae, peritoneum of the adjacent

region, and the pelvic bones. They also receive vessels from the prefemoral and coxal lymph glands.

The efferent vessels go in part to the receptaculum chyli and in part to the internal iliac or deep inguinal lymph glands.

THE INTERNAL ILIAC LYMPH GLANDS

The internal iliac lymph gland in cattle is a large, heart-shaped gland 2 or more inches in diameter, located at about the upper third of the pelvic arch in the obtuse angle formed by the external iliac artery and the abdominal sort (fig. 7, *D*). In hogs there are several glands at this location which are continuous with the lumbar lymph glands (fig. 3, *E*).

The afferent vessels are derived from the prefemoral and superficial inguinal lymph glands, walls of the posterior abdominal and pelvic cavities, the rectum, internal genital organs, urinary bladder, pelvis, and sacrum. Some of the efferent vessels go to the lumbar lymph glands and some direct to the receptaculum chyli.

In a hanging beef carcass this gland may be easily felt by placing the hand on the inner face of the ilium at about the upper third of the border of the pelvic arch.

THE ANAL LYMPH GLANDS

The anal lymph glands are very small glands located in the fatty tissue on the floor of the pelvis laterally from the anus (fig. 3, *F*; fig. 7, *E*). The efferent vessels are derived from the anal region, root of the tail, and surrounding tissues. The efferent vessels go to the internal iliac lymph glands.

THE LUMBAR LYMPH GLANDS

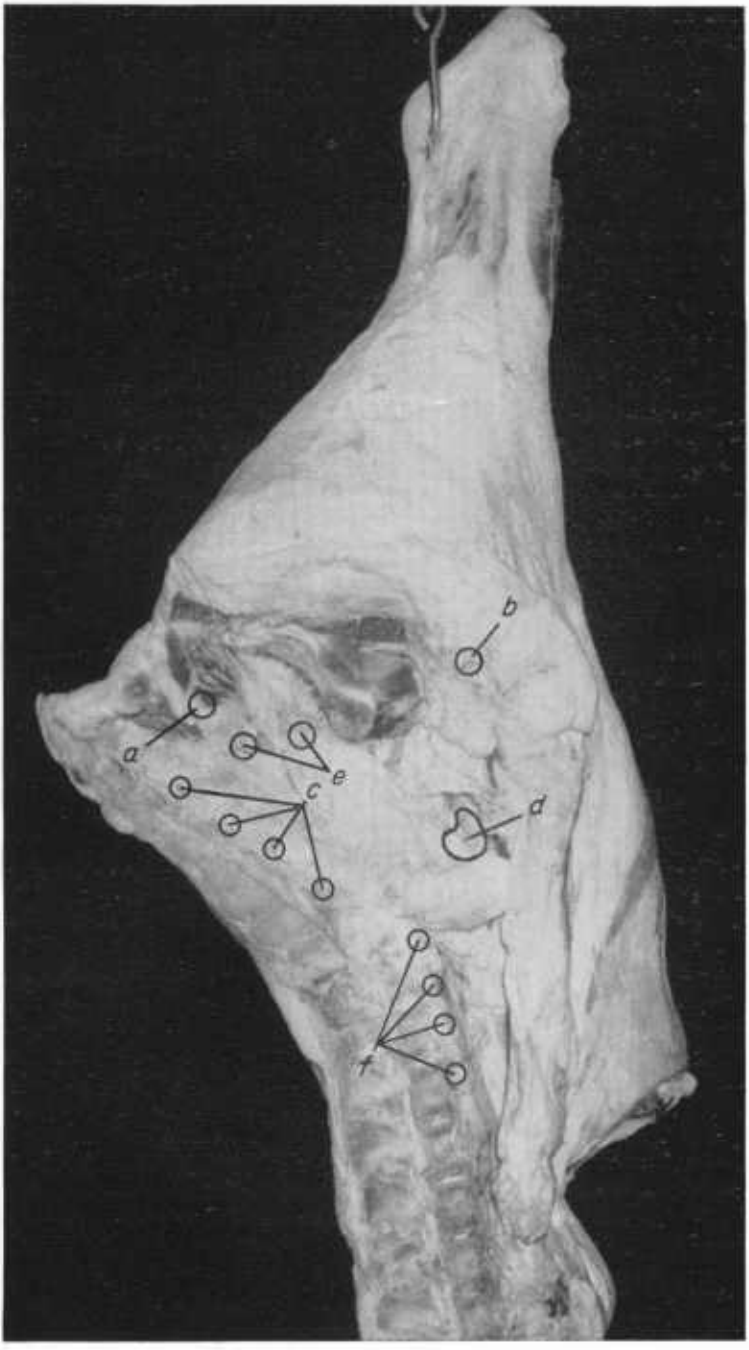
The lumbar lymph glands are located in the sublumbar region along each side of the abdominal aorta and are usually embedded in the fatty cushion bordering the large blood vessels of the sublumbar region (fig. 3, *G*; fig. 7, *F*; fig. 8, *E*).

The afferent lymph vessels come from the lumbar muscular masses and the posterosuperior abdominal walls. These lymph glands also receive the lymph from nearly all the lymph glands lying posterior to them, that is, the internal iliac and sacral glands and from the internal sexual organs, lumbar vertebrae, and urinary organs. It will thus be seen that these are important lymph glands, as they receive lymph from all the lymphatic vessels of the posterior limbs, pelvis, abdominal walls, and the inguinal region.

The efferent vessels go to the lumbar trunk and the receptaculum chyli, lying just beneath the kidneys between the suspensory ligaments of the abdominal visceral organs.

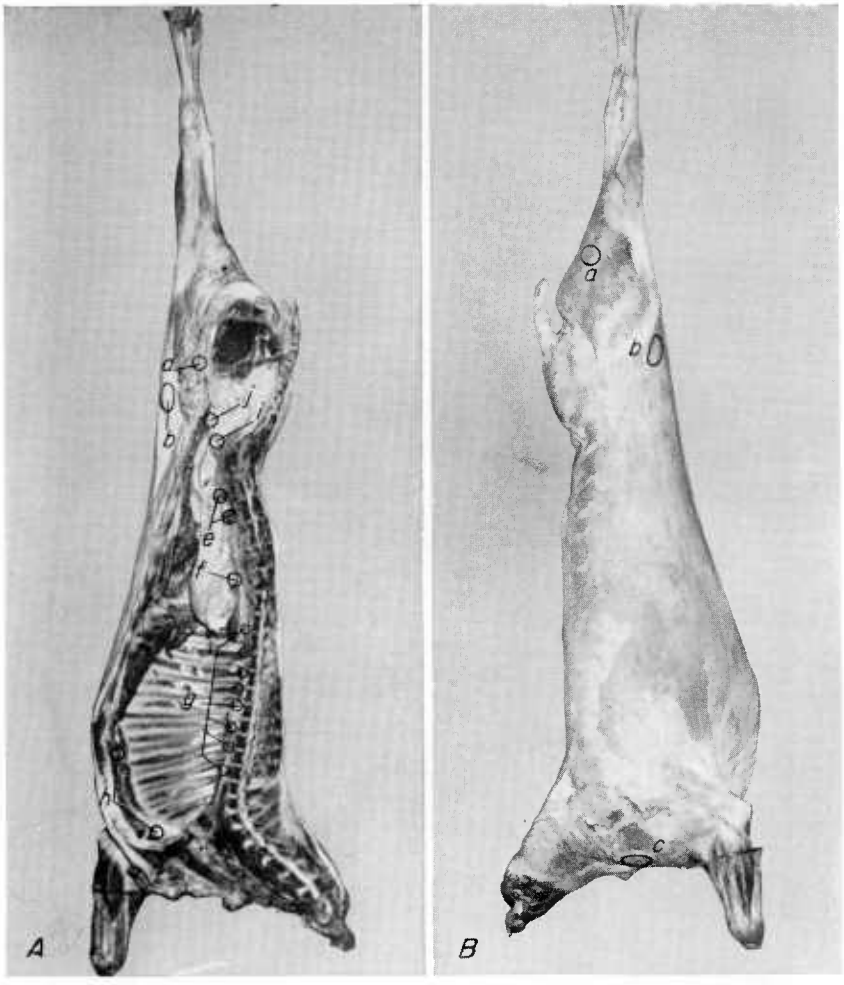
THE RENAL LYMPH GLANDS

The renal lymph glands in cattle are located in the fatty tissue in the hilus of the kidney on the course of the renal artery. In swine they are located on each side of the renal artery where it branches



12051-A

FIGURE 7.—Hindquarter of beef, internal view. *a*, Ischiatic lymph gland; *b*, superficial inguinal lymph gland; *c*, sacral lymph glands; *d*, internal iliac lymph glands; *e*, anal lymph glands; and *f*, lumbar lymph glands.



12044-A, 12043-A

FIGURE 8.—Internal (*A*) and external (*B*) view of split sheep carcass. *a*, Popliteal lymph gland; *b*, prefemoral lymph gland; *c*, prescapular lymph gland; *d*, superficial inguinal or supramammary lymph gland; *e*, lumbar lymph glands; *f*, renal lymph gland; *g*, intercostal lymph glands; *h*, sternal lymph glands; *i*, internal iliac lymph gland; and *j*, external iliac lymph gland.

off from the aorta. These lymph glands consist of several small glands, usually one anterior and two posterior to the renal artery and not far from the hilus of the kidney. The afferent vessels come from the kidneys. The efferent vessels lead directly to the receptaculum chyli which lies immediately adjacent to these lymph glands.

THE GASTRIC LYMPH GLANDS

The gastric lymph glands are located in cattle in the folds and fissures of the divisions of the compound stomach, especially between

the second stomach (reticulum) and the fourth or true stomach (abomasum) and on the course of the gastric blood vessels. On the great curvature of the fourth stomach there are also a number of small lymph glands.

There are three or four large gastric lymph glands in swine. They are located in the lesser curvature of the stomach and are covered by the pancreas.

The afferent vessels are derived from the superficial parts of the walls of the stomach, and from the submucosa of the stomach. The efferent vessels go upward through the gastric omentum into the receptaculum chyli. A small lymph area on the fundus of the stomach of the hog passes up through the gastrosplenic ligament to the splenic lymph gland lying in the hilus of the spleen.

THE MESENTERIC LYMPH GLANDS

The mesenteric lymph glands in cattle are located in the "ruffle fat" along the lesser curvature of the intestines in the folds of the mesentery, and consist of a continuous chain of glands from the abomasum to the cecum (fig. 11, *A*). These lymph glands are cylindrical segments and vary in size and consistence according to the stage of digestion, being more voluminous and containing a greater amount of fluid immediately after or during the digestive period.

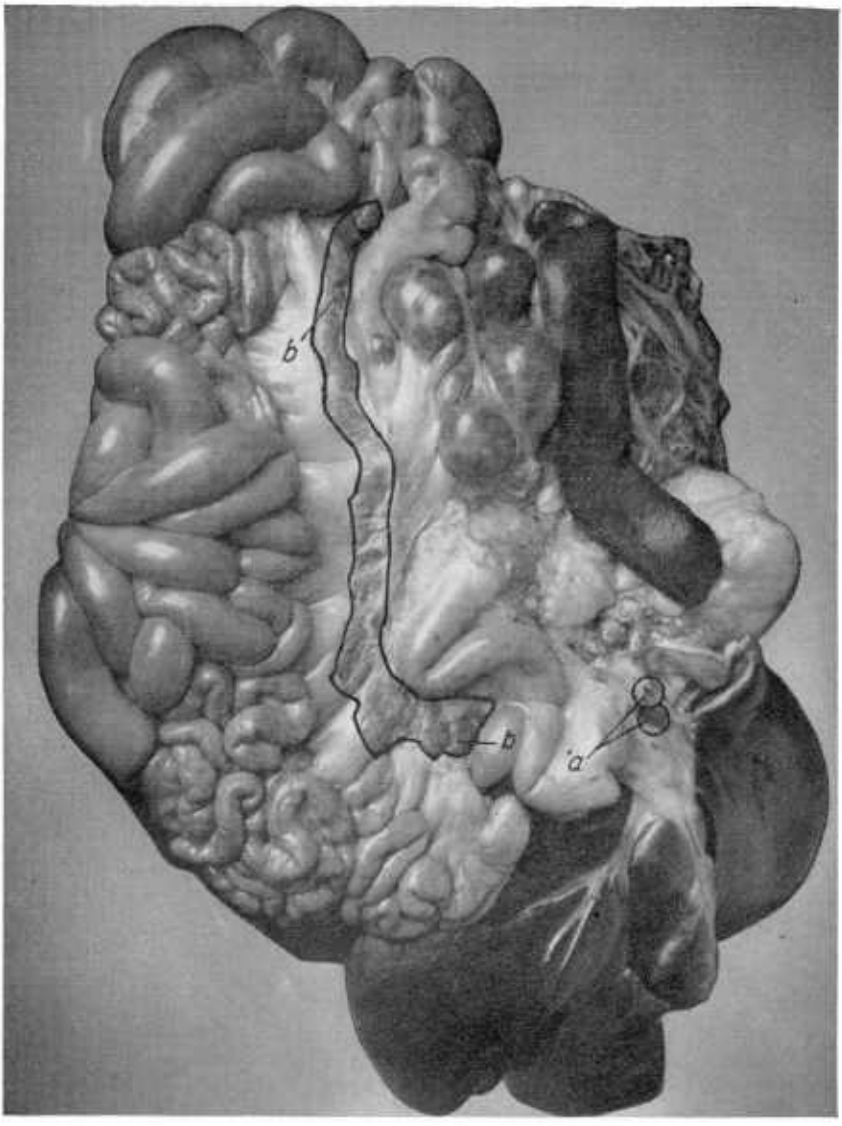
The chain of glands in swine is very similar to that in cattle, except that the glands are further removed from the intestines, being near the middle of the mesentery (fig. 9, *B*).

In sheep the mesenteric lymph glands are located as in cattle. They do not contain many interrupted glands, however, but are long, cylindrical structures which have the appearance of being fused into one long, continuous mass.

To detect disease in cattle, hogs, or sheep, an examination of these glands is very important as one or all of them frequently present lesions. In a number of cases, especially in hogs, they are affected when no other lesions of disease can be found in the carcass. With deft strokes of the knife, an experienced inspector can incise and lay these lymph glands open for inspection. Some skill is required to place the intestines in just the right position on the table to make a thorough examination.

The afferent lymph vessels are derived from the very rich lymph and chyle plexuses in the submucosa of the intestines. It is through the medium of these vessels that the chyle is transported. The chyme of the intestines furnishes the lacteals and intestinal villi with material from which the chyle is abstracted, and this passes through these structures to the chyliferous capillary plexuses in the intestinal wall then into the afferent vessels of the mesenteric lymph glands. The efferent vessels of these lymph glands—sometimes called lacteals from the milky appearance of their liquid contents—pass through the whole width of the mesentery to the receptaculum chyli.

Also on the colon are a number of small lymph glands, lying in the folds, which receive the lymph from the walls of the colon and pass it on to efferent vessels leading to the receptaculum chyli.



12031 A

FIGURE 9.—Abdominal viscera of hog. *a*, Hepatic lymph glands; *b*, mesenteric lymph glands.

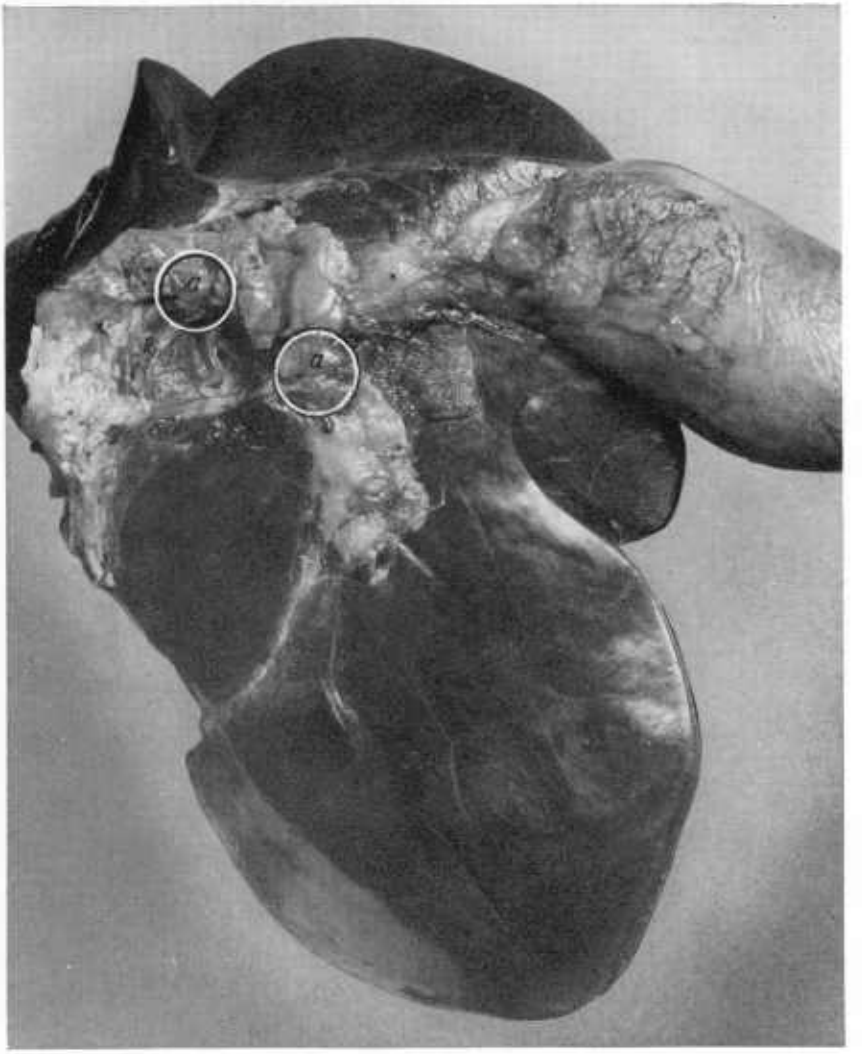
THE SPLENIC LYMPH GLANDS

The splenic lymph glands in hogs are located in the gastrosplenic omentum at the hilus of the spleen near the superior extremity. In cattle these glands lie at the hilus of the spleen between the folds of the splenic ligament. The afferent lymph vessels come from the superficial and deep portions of the spleen and in the hog also from the fundus of the stomach. In cattle it is likely that a few lymph vessels

come from the stomach walls. The efferent vessels lead to the receptaculum chyli.

THE HEPATIC OR PORTAL LYMPH GLANDS

The hepatic or portal lymph glands, from three to five in number, are located in cattle on the posterior surface of the liver, and are embedded in the fatty cushion surrounding the vessels entering at the portal fissure (fig. 10, *A*). In hogs they are grouped about the portal vein, hepatic artery, and the bile duct, and are covered by the pancreas. Some are also ventral to the pancreas (fig. 9, *A*).



12034-A

FIGURE 10.—Gastric surface of beef liver. *a*. Hepatic lymph glands.

FIGURE 11.—Intestines of cattle as presented for inspection. *a*, Mesenteric lymph glands; *b*, colic lymph glands.

The afferent lymph vessels are found in the greater part of the anterior surface, all of the posterior surface, and in the entire glandular part of the liver. The efferent vessels pass upward along with those of the stomach into the receptaculum chyli.

THE INTERCOSTAL LYMPH GLANDS

The intercostal lymph glands in cattle are located in the intercostal spaces, embedded in the intercostal muscles and covered by the costal pleura, along each side of the thoracic vertebrae. Their afferent vessels are derived from the intercostal muscles, dorsal muscles, dorsal vertebrae, parietal pleura, and partly from the periosteum

and the diaphragm. The efferent vessels pass forward and empty into the mediastinal lymph glands or into the thoracic duct.

In hogs these glands are absent, but a chain of lymph glands lies on the aorta just under the dorsal vertebrae.

THE STERNAL LYMPH GLANDS

The sternal lymph glands are located along the course of the internal thoracic vein and artery and are covered by the transversus thoracis muscle at the lower end of the intercostal spaces, superior to the sternum. In cattle one of these sternal lymph glands is embedded in the fatty tissue at the junction of the diaphragm with the sternum (fig. 5, *A*).

The afferent vessels are derived from the rectus abdominis, intercostal muscles, parietal pleura, and diaphragm. The efferent vessels lead to the prepectoral lymph glands or to the tracheal duct on the right side and to the thoracic duct on the left side.

In hogs the sternals are usually absent, but in their place is a large, single lymph gland at the articulation of the first and second segments of the sternum (fig. 3, *H*).

In sheep there is a sternal lymph gland and a lymph gland disposed in the same manner as in the hog, just above the first or second segment of the sternum (fig. 8, *H*).

THE LYMPH GLANDS OF THE THORACIC VISCERA

The lymph glands of the thoracic viscera may be divided into two groups, bronchial and mediastinal. The bronchial lymph glands are located on the walls of the trachea near the branching of the main bronchial tubes which are given off to the different lobes of the lungs. The mediastinal lymph glands are termed anterior or posterior according to their location in the mediastinum.

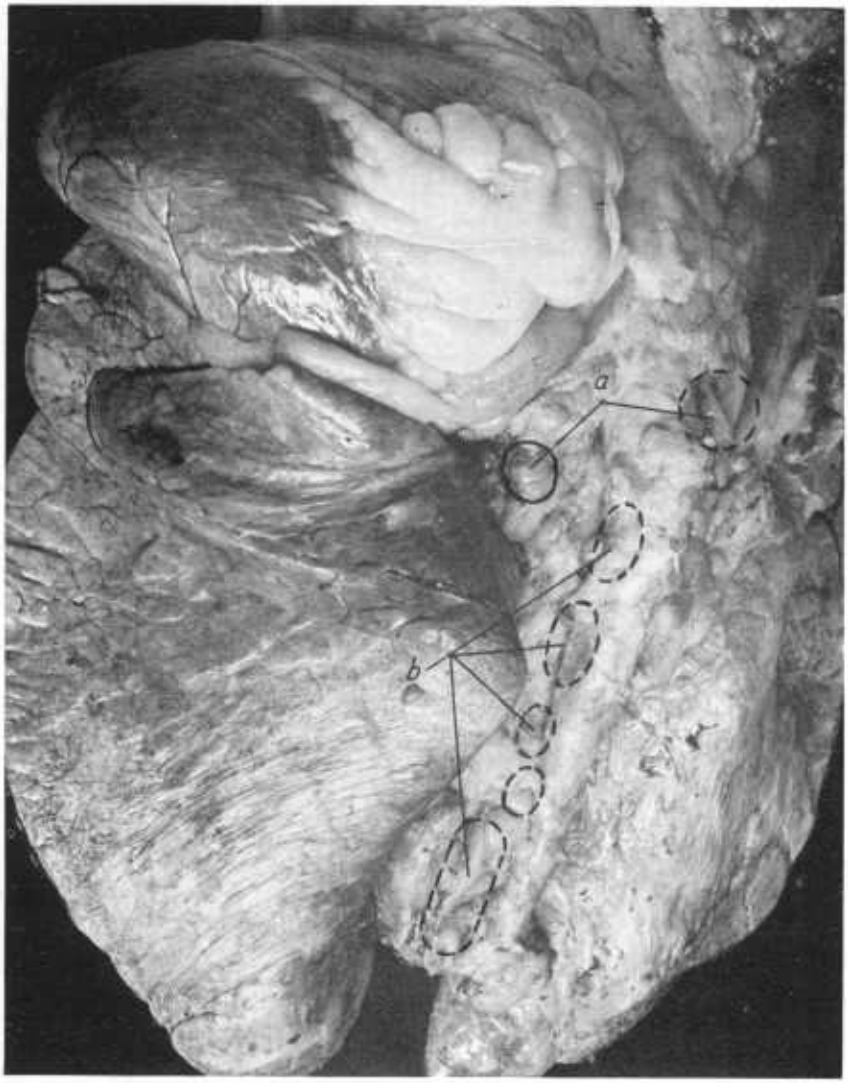
The groups of lymph glands in the region of the lungs (bronchials and mediastinals) are very important to the inspector and should be carefully examined in every case before a carcass is passed for food. This is especially important in cattle where these glands are a favored seat of infection. In sheep these glands may show the lesions of caseous lymphadenitis.

In hogs the bronchial lymph glands are very well developed and are found usually in pairs in relatively the same location as in cattle. In hogs the efferent vessels lead directly to the thoracic duct. Along the course of the phrenic nerve as it passes the base of the heart are many small hemolymph glands embedded in the fatty tissues on either side of the nerve.

Against the pericardial sac just under the trachea is a gland which receives the vessels from this part of the trachea and from the visceral pleura. Also on the visceral pleura, against the inner surface of the left lung, lies the small pericardiac lymph gland which receives afferents from adjacent tissues.

The Right Bronchial Lymph Glands

The right bronchial lymph glands, about four in number, are located along the trachea at the juncture of the bronchus of the right



12035-A

FIGURE 12.—Thoracic viscera of cattle. *a*, Bronchial lymph glands (right and left); *b*, mediastinal lymph glands.

apical lobe and the juncture of the bronchus of the main lobe with the trachea (fig. 12, *A*; fig. 13, *A*).

The afferent vessels are derived chiefly from the lungs, the thoracic part of the esophagus, and the heart.

The efferent vessels lead to the mediastinal lymph glands.

THE LEFT BRONCHIAL LYMPH GLANDS

The left bronchial lymph gland in cattle and hogs is located on the left side of the trachea, anteriorly to and near the left bronchus,

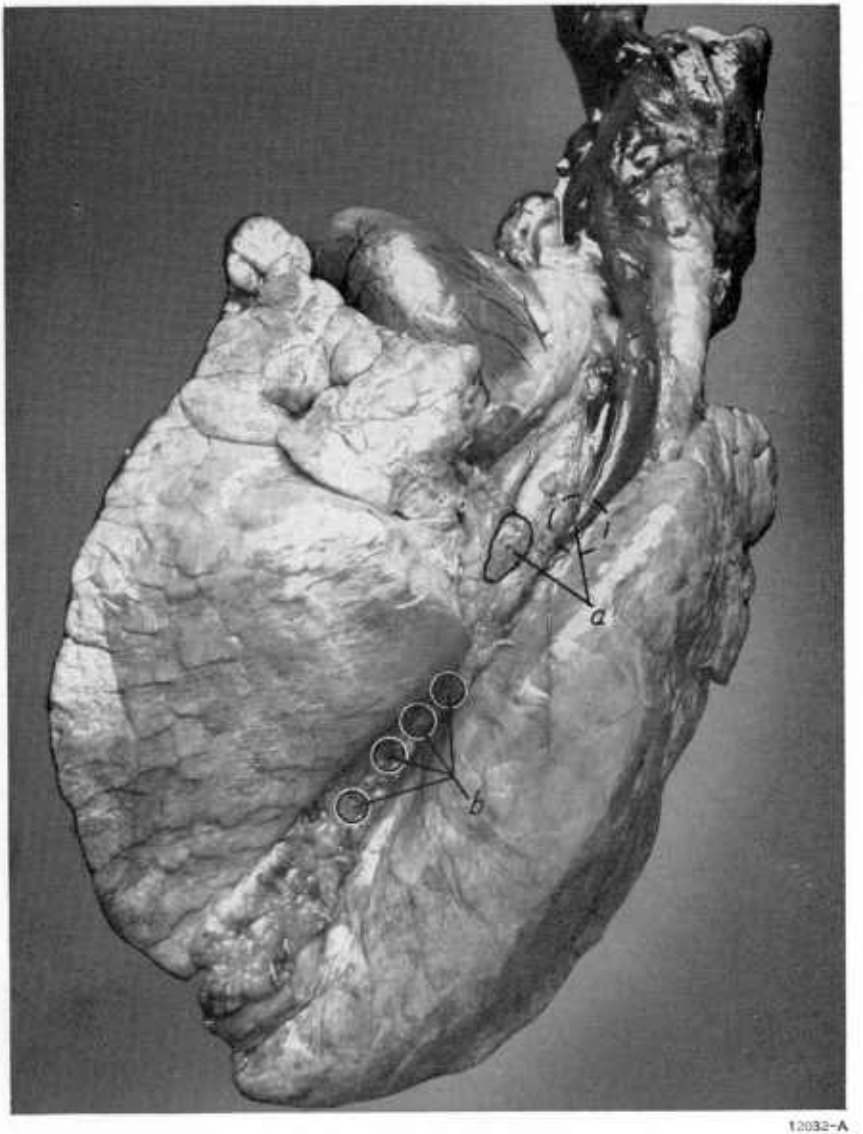


FIGURE 13.—Thoracic viscera of hog. Left apical lobe of lung is removed. *a*, Bronchial lymph glands (right and left); *b*, mediastinal lymph glands.

and is normally the largest of the bronchial lymph glands (figs. 12, 13, *A*–2). It receives afferent lymph vessels from the left lobe of the lung and the heart, and the efferent vessels lead to the mediastinal glands. The bronchial glands of hogs are usually found in pairs. In cattle there is usually a large single gland, rather deeply lobulated, so that it appears almost like several glands grouped together. This gland is examined in the slaughtering department by grasping the anterior lobe of the left lung with one hand and incising across the

left bronchus at the root of this lobe so as to cut into and expose the lymph gland.

The Anterior Mediastinal Lymph Glands

The anterior mediastinal lymph glands are located in the folds of the anterior mediastinum in variable numbers. They are small and are distributed along the inferior and lateral parts of the trachea and esophagus at the thoracic inlet.

Their afferent vessels are derived from the pleura, esophagus, pericardium, and heart, and the efferent vessels from the bronchial lymph glands, thymus, and small lymph glands along the course of the phrenic nerves. The efferent vessels lead either to the thoracic duct and right lymphatic duct or to the prepectoral lymph glands before entering the large terminal lymph trunks.

These lymph glands usually remain in the cattle carcass when the lungs are removed, and in the dressed carcass the whole group is sometimes found on one side or one-half may be found on each side of the carcass embedded in the mass of fat just superior to the anterior segment of the sternum.

The Posterior Mediastinal Lymph Glands

The posterior mediastinal lymph glands are situated along the esophagus from the aortic arch posteriorly to the diaphragm. These lymph glands are located in two main groups. The anterior or smaller of these two groups is sometimes called the median mediastinal lymph glands. The lymph glands in both groups vary in size (figs. 12 and 13, *B*).

The afferent vessels come from the esophagus, lungs, pericardium, mediastinum, peritoneum, liver, right bronchial lymph gland, and the spleen. The efferent vessels empty directly into the thoracic duct.

A part of this lymph gland may be left in the dressed carcass, adjacent to the pillars of the diaphragm, and should always be removed and examined as it is a frequent seat of lesions of disease. The anterior gland of the posterior mediastinal group (the median mediastinal) is occasionally left in the carcass, where it can be found attached to the inferior dorsal muscles to the right of the aorta about opposite the interspace between the fourth and fifth ribs. This portion of the lymph gland is often erroneously considered to be the anterior mediastinal lymph gland.

In hogs, along the superior surface of the aorta, are four or five small lymph glands which may be regarded as corresponding to the posterior group of mediastinal lymph glands found in cattle.

OTHER LYMPHATIC STRUCTURES

Besides the lymphatic structures already described, there are many lymphatic tissues throughout the carcass, of which brief mention should be made. Some of the organs contain lymphatic cellular aggregations, more or less extensive, yet hardly large enough to be classed as lymph glands.

Very small lymph glands are found along the course of the smaller bronchi in the lungs.

The spleen is very rich in lymphatic tissues which compose the Malpighian bodies that show up prominently when the organ is sectioned and appear as small whitish nodules in the red matrix.

In the intestines the lymphatic tissues compose what are known as solitary follicles and the agminated follicles or Peyer's patches. In the terminal part of the small intestine of the hog a Peyer's patch forms itself as a band 4 or 5 feet in length.

In the mucous membranes of other parts also are many lymph follicles, as in the soft palate and the base of the tongue, but particularly in the tonsils and in the posterior nares.

Attention is called to spaces surrounding blood vessels of the brain, known as perivascular lymph channels, and around nerve trunks, called perineural lymph sheaths. These spaces are not dependents of the large lymph system.

Both the pleural and the peritoneal cavities are thought to be in open communication with the lymph vessels; in the pleura the openings occur in the intercostal spaces, and in the peritoneum on the pillars of the diaphragm. The openings of communication are called stomata. Normally these cavities contain only sufficient lymph to lubricate the contained viscera.

U. S. GOVERNMENT PRINTING OFFICE: 1951

For sale by the Superintendent of Documents, U. S. Government Printing Office
Washington 25, D. C. - Price 15 cents